# Introduction

The inaugural State of Spring 2020 report found that organizations are using Spring to deliver production results day after day, even as modern architectural patterns and multi-cloud infrastructure become the norm. This year, the Spring portfolio continues to see strong, sustained adoption across small, medium, and enterprise companies. Spring is the Java framework of choice—94% of Spring developers agree that the framework makes them more productive.

This year's survey has been substantially expanded. It checks in on the Spring Community, and double-clicks on important topics like the adoption and use of Spring Projects, the growing use of modern development methods, and important technologies to keep an eye on.

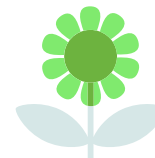## This report is divided up into four sections:

**A Thriving Community**

Developers love Spring's open source roots and productivity benefits

**Spring Projects are Evergreen**

A range of projects are capturing attention and fueling growth

**APIs and Modern Apps Blossoming**

Modern methods continue to gain ground

**Branch Out with Spring Native**

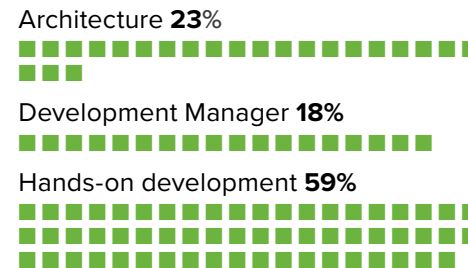Native is a fertile area with a bright future

# Demographics

VMware commissioned Dimensional Research to conduct this second annual study to understand the experiences and attitudes of individuals responsible for adoption and use of Spring. Our study surveyed active Spring developers, architects, and development managers across organizations of different sizes. This year's survey repeated several questions from last year to identify trends. It also included new questions covering a range of topics surfaced in last year's report.

Our 2021 survey reached a total of 1,586 qualified individuals. A wide range of roles, regions, and job levels are represented. In particular, 59% of respondents were hands-on developers, 18% were development managers, and 23% were architects—proportions that we think are reflective of the real world.
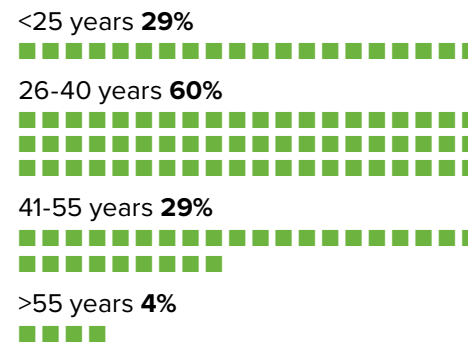
The vast majority (80%) of developers and other stakeholders surveyed had 3 or more years of experience working with Spring. 60% of respondents were in the 26-40 age group, an increase of 5% from last year's survey. For a technology that's been around as long as Spring, the strength of this younger demographic shows that developers are still very much drawn to Spring.

This research covers a wide range of Spring stakeholders in industries including technology companies (27%) and financial services and insurance companies (20%). All major sectors are represented, including retail (6%), services (6%), government (5%), and healthcare (5%). This year's data also breaks out companies with more than 100,000 employees, which account for 5% of companies reached. It is encouraging to see that Spring is a key technology across such a wide range of company sizes.
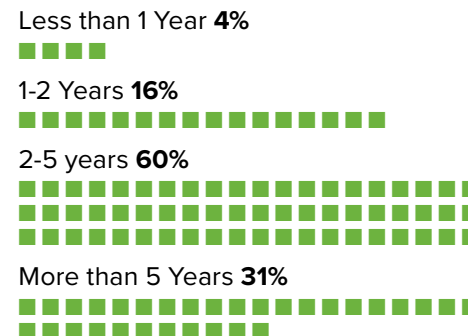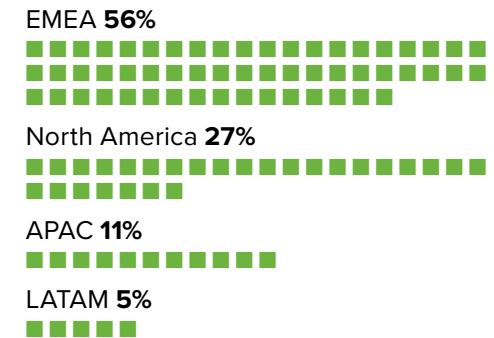
## Role

Architecture **23**%

Development Manager **18%**

Hands-on development **59%**

## Age

<25 years **29%**

26-40 years **60%**

41-55 years **29%**

>55 years **4%**

## Years of experience with Spring Boot

Less than 1 Year **4%**

1-2 Years **16%**

2-5 years **60%**

More than 5 Years **31%**

## Region

EMEA **56%**

North America **27%**

APAC **11%**

LATAM **5%**

## Company Size (Employees)

<100 **26%**

100-500 **20%**

500-1,000 **12%**

1,000-5,000 **15%**

5,000-10,000 **8%**

10,000-100,000 **13%**

>100,000 **5%**
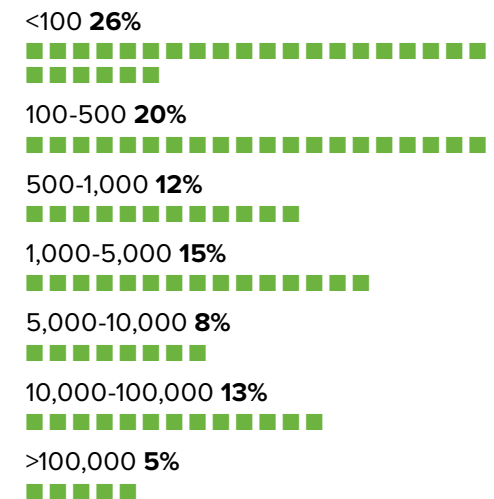
# A thriving community

For nearly two decades, Spring has been all about developer productivity and code velocity. For the Spring Community, it remains the framework of choice for building applications quickly to respond to change. This year we look at developer productivity, how companies leverage Spring expertise, and ways in which you can contribute back to Spring.

## Spring use continues to grow

In last year's survey, 52% of organizations reported that Spring Boot was their primary or only development platform. For 2021, that **number grew 9%**, to 61% of organizations.

When asked what they like about Spring, roughly two-thirds of respondents selected the following options: *works out of the box but is still flexible*; *it's very stable, scalable and secure*; and *good expertise and support in the community*. But, the number one thing that people like about Spring is: *it's open source software*.

**52%**

**2020**

**61%**

**2021**
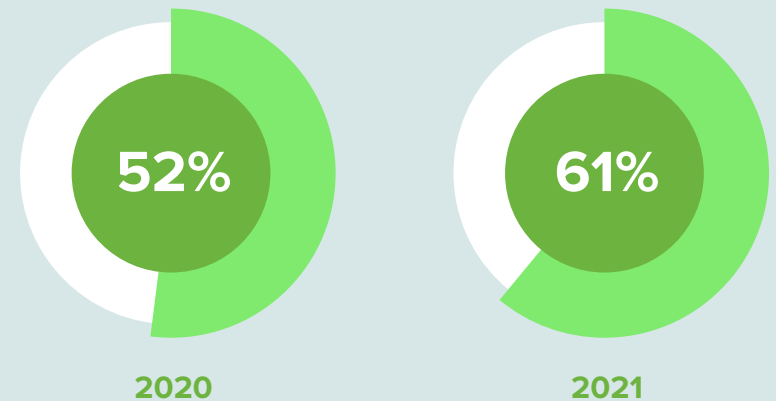
61% of developers surveyed use Spring Boot as their only or primary development platform

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## Spring is fantastic for developer productivity

When asked, 67% of managers, 66% of architects, and 50% of developers strongly agreed that they care deeply about developer productivity, and Spring delivers…95% of respondents agreed that *Spring Boot has a huge positive impact on productivity*, and 91% agreed that, *compared to other Java development platforms, Spring has a bigger impact.*
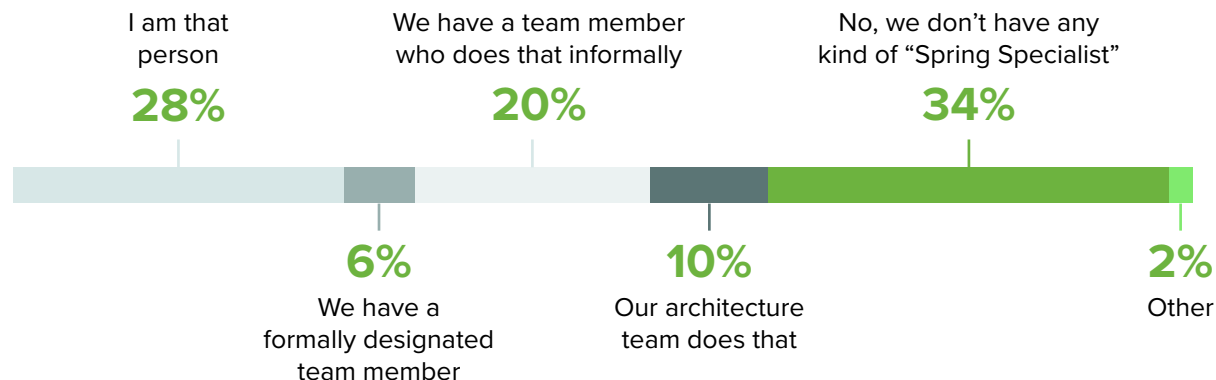
**95%**
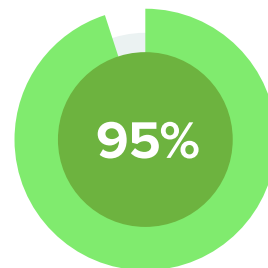
of respondents say Spring Boot has a huge positive impact on developer productivity

**91%**
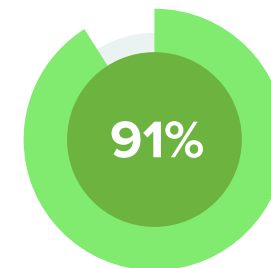
of respondents say Spring has a bigger impact on developer productivity than other Java platforms

## Does your team have a Spring specialist?

We're always interested in learning more about how development teams disseminate Spring knowledge. When we asked who the "Spring Specialist" was that kept their teams up-to-date, 28% of respondents said *I am that person*. Another 26% had either a formally designated team member performing the function or someone who did it informally. 10% surveyed relied on their architecture team for Spring expertise.

I am that person
**28%**

We have a team member who does that informally
**20%**

No, we don't have any kind of "Spring Specialist"
**34%**

We have a formally designated team member
**6%**

Our architecture team does that
**10%**

Other
**2%**

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# Where do developers learn about Spring?

One of the great things about Spring is that there are so many resources to learn from. In this year's survey, Stack Overflow—which features Q&A on a wide range of programming topics—edged out Spring.io as the most popular source of Spring information, with 75% of respondents selecting it; Spring.io, with its wide-ranging content, was a close second at 71%.

Survey respondents visit Spring.io for all kinds of reasons. The site doesn't just help you *stay up to date with new releases and news* (61% of respondents use the site for this purpose), you can also visit to *find sample code* (58%), *solve a specific problem* (52%), *learn to use a new area of Spring* (51%) and much more.

When we asked people what improvements they'd like to see in Spring.io, almost 60% said they have trouble finding the content they are looking for. Specific things stakeholders would like to see more of include: *tutorials, guides, sample code and how-to articles* (70%) and *reference architectures and patterns* (64%). We'll be looking at what we can do to improve site usability in the coming year.

## How can I contribute to Spring and help the Spring Community?

Every contribution to Spring is important, be it code, documentation, a bug report, or answering a question. A very effective way to contribute is to work on a feature you are already using for a project. If you identify an issue or an area for improvement, we recommend reporting the issue to us to get the discussion started. That can lead to a pull request (PR) down the road.

You may also find opportunities to contribute at the following links:

- **High quality issues with repro projects and detailed descriptions**
- **First-timers only**

Contributing code is not the only way to participate. You can also help by improving documentation, proposing new ideas and reporting bugs (with sample code). Responding to StackOverflow questions can be a great way to help others *and* build your own knowledge. If you notice something missing or incorrect in the documentation, don't forget to report it or improve it.

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# Spring Projects are evergreen

One of the keys to Spring's enduring appeal and reputation for innovation is the many modules that accelerate code delivery. From configuration to security, web apps to streaming data—whatever the infrastructure needs of your application, there is a Spring Project to help you build it.

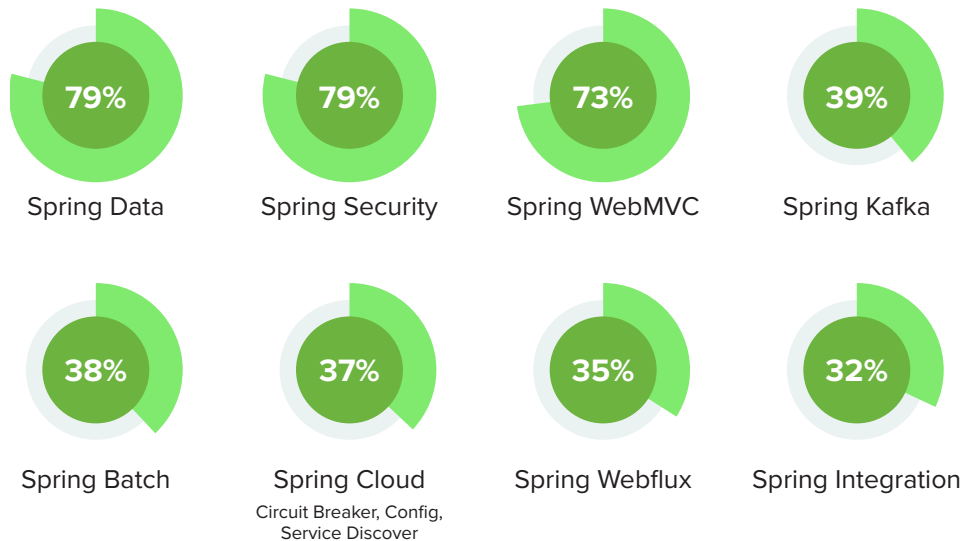## What do users like about Spring Projects?

This year, we went a little deeper to find out more about key projects. Almost half of respondents said they appreciated that *"new modules are consistently added to keep up to date with the latest technology"* and that *"the breadth of modules provides confidence that Spring has what we need."* Almost 40% of respondents said they would be using more Spring modules in coming years. When asked about areas that could be improved, 24% chose *"lack of information about how to use modules together."*

**Stakeholders trust Spring Projects**

**49%**
new modules are consistently added to keep up to date

**47%**
the breadth of modules provides confidence Spring has what we need

**39%**
we'll be using more Spring modules in coming years

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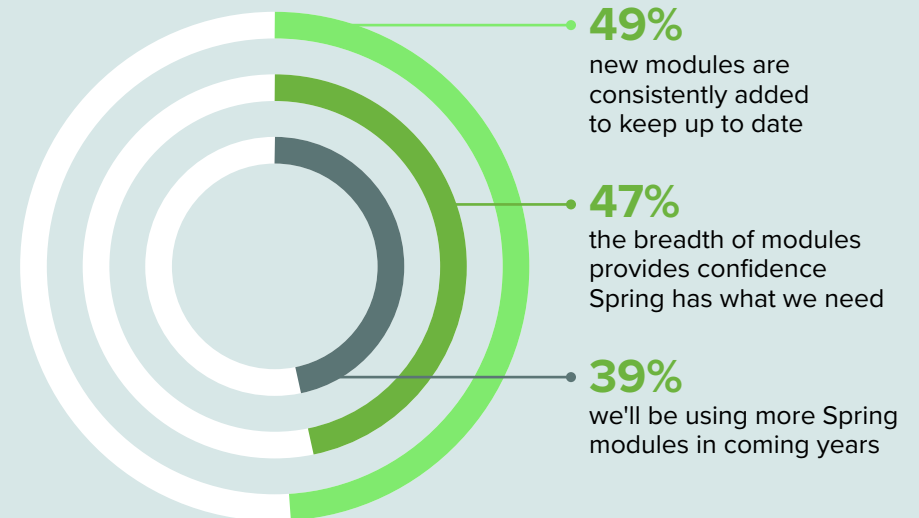
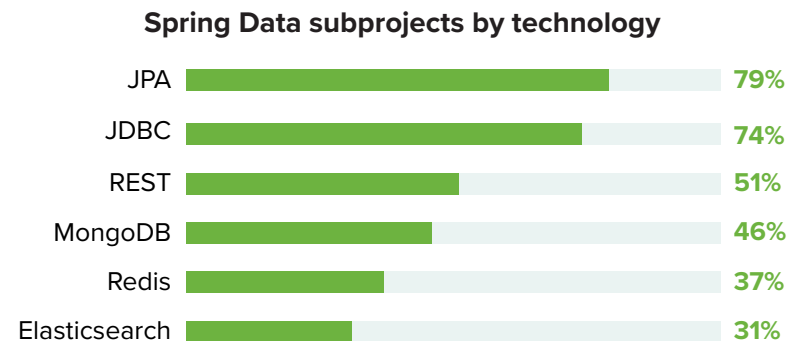spring®

# What are the top Spring Projects?

The top 3 projects this year remain the same. Spring Data, Spring Security, and Spring WebMVC are all used by roughly three in four survey respondents. However, these aren't the only Spring modules that see significant use. Spring Kafka, Spring Batch, Spring Cloud, Spring WebFlux and Spring Integration are all used by roughly a third of respondents, while a quarter use Spring Session, Spring LDAP, Spring AMQP, and Spring Cloud Gateway. (More on Spring Cloud Gateway later.)

| | | | |
|---|---|---|---|
| **79%** | **79%** | **73%** | **39%** |
| Spring Data | Spring Security | Spring WebMVC | Spring Kafka |
| **38%** | **37%** | **35%** | **32%** |
| Spring Batch | Spring Cloud<br>Circuit Breaker, Config,<br>Service Discover | Spring Webflux | Spring Integration |

# Data, data everywhere

Applications are only as good as their data. Complex applications may use multiple data sources—across multiple clouds. Spring Data makes it easy to use data access technologies, relational and non-relational databases, map-reduce frameworks, and cloud-based data services—with subprojects for particular technologies.

Spring Data JPA, which makes it easy to implement Java Persistence API-based repositories, tops the list of subprojects, selected by 79% of stakeholders. Spring Data JDBC (Java Database Connectivity), which defines an API for connecting to and querying almost any relational database, ranked second at 74%. Several modules for non-relational databases were also popular, including MongoDB (46%), Redis (37%) and Elasticsearch (31%).

### Spring Data subprojects by technology

| | |
|---|---|
| JPA | **79%** |
| JDBC | **74%** |
| REST | **51%** |
| MongoDB | **46%** |
| Redis | **37%** |
| Elasticsearch | **31%** |

# Which Spring Project should you pick?

While business needs and architecture requirements are always primary considerations, we wanted to understand all the factors that go into evaluating Spring Projects and giving them the thumbs up or thumbs down.
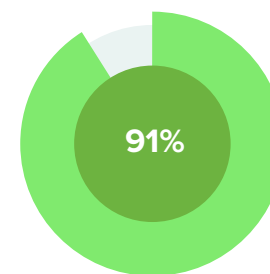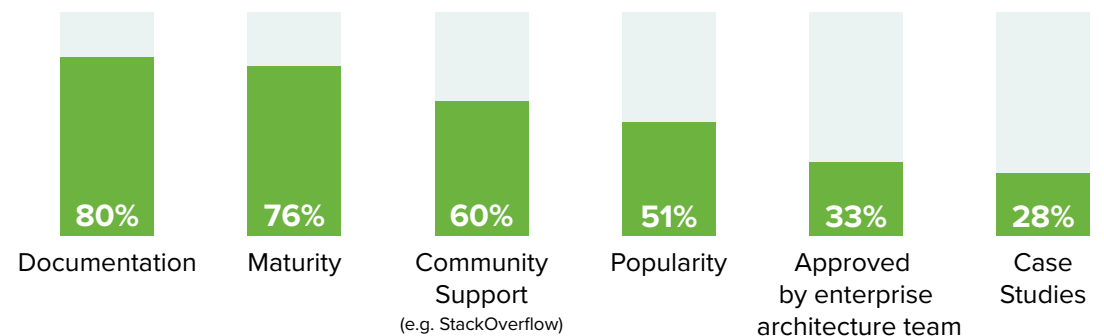
The number one criterion is documentation (chosen by 80% of respondents). Clear, well-organized documentation is always a positive sign. Maturity was a close second at 76%. One in three respondents said they were limited to projects approved by their enterprise architecture team.

**Criteria considered when deciding to use a new Spring module**

| 80% | 76% | 60% | 51% | 33% | 28% |
|-----|-----|-----|-----|-----|-----|
| Documentation | Maturity | Community Support (e.g. StackOverflow) | Popularity | Approved by enterprise architecture team | Case Studies |

# Kotlin gains ground

Spring supports three programming languages: Java, Groovy, and Kotlin—an object-oriented language that includes many ideas from functional programming, first introduced in 2016. We always want to understand what new technologies are gaining traction, and Kotlin appears to be a winner.

More than 40% of respondents are already using Kotlin to create Spring projects (18% are using it extensively), and an additional 18% plan to use it. Nine out of ten expressed positive sentiment toward Kotlin, the highest positive response of any of the 15 new technologies covered in our survey.

91%

Have a positive view of Kotlin

59%
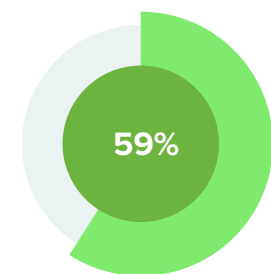
Use or plan to use Kotlin

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# APIs and modern apps are blossoming

With capabilities like microservices, Reactive, and Serverless, Spring is leading the charge towards modern architectures. This year we dug deeper to understand why Spring has become the framework of choice for modern apps and to explore trends in APIs, API management and observability.

## APIs are the top Spring use case

A whopping 97% agreed that *"APIs are critical to our Spring development efforts."* To learn more about API usage, we broke apart APIs for internal versus external consumers. These are the number one and number three use cases this year. *Business applications* fell to number two.

Since internal APIs have become such an important use case, it will be interesting to learn what internal API marketplaces people are using and how they discover and try out APIs. Look for questions on those topics next year.
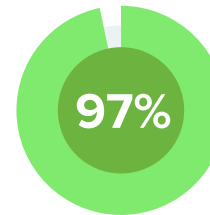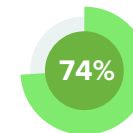
**97%** of respondents say APIs are critical to their Spring development efforts

### Types of applications organizations use Spring Boot for
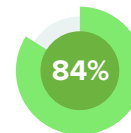
**84%**
Expose APIs to internal consumers

**74%**
Business applications

**68%**
Expose APIs to external consumers

**Need better tools to cope with proliferating APIs?**

As internal and external APIs proliferate, you need tools to help reduce the complexity of tasks like designing new APIs, updating existing APIs, or discovering what APIs are available.

**Spring Cloud Gateway** provides a developer-friendly way to route, secure and monitor API requests. Interest in this open source project is soaring, along with a spike in interest in our commercially supported version, **Tanzu Spring Cloud Gateway**.

**API portal for VMware Tanzu** enables developers to discover and manage internal APIs, improving collaboration between API producers and consumers and across teams and departments.

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## More than four in five are using modern app architectures...

One of the benefits of Spring is that it helps developers stay up to date with modern technologies, so they don't have to constantly learn new languages or frameworks; 86% use modern architectural styles with Spring—microservices are used by pretty much everyone (94%) while 35% use Reactive and 19% use Serverless.

## And adopting related modern technologies...

Two out of three are using API management and observability in their Spring environments. Given that APIs are the top Spring use case, it shouldn't come as a surprise that people are also using API management/API gateways. And, once you start using APIs and microservices, observability becomes that much more critical.

Nearly 1 in 3 are adopting event streaming and 1 in 4 are using GitOps. The adoption rate for event streaming aligns closely with that for Spring Kafka as mentioned above (Kafka being an important and popular event streaming technology). We added GitOps—the use of Git tools to automate infrastructure management—to this year's survey in recognition of the buzz it has received over the last year or so.

## Plus emerging backend tech

When we asked what types of APIs people use, JSON over HTTP (84%) and OpenAPI (57%) were at the top. But, we were surprised that 20% are already using GraphQL, an open source data query language for APIs. The recent introduction of the Spring GraphQL project will make incorporating GraphQL into your Spring applications a snap.

**86%**
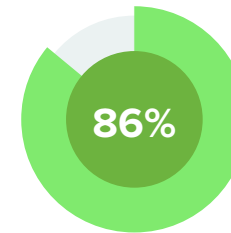
**of respondents are using modern architectural styles**

### Observability essential for modern app success

Distributed applications create new challenges. A request to a microservice can result in a cascading chain of calls. Observability enables developers and operators to more easily pinpoint problems in distributed systems by correlating metrics, interpreting complex data and providing actionable information.

With Tanzu Observability, Spring developers can easily send metrics, traces, and span logs to build dashboards that help monitor modern applications and help troubleshoot service health issues. Get started with a freemium tier account, available to all developers using Wavefront for Spring Boot.

For more Observability insights, check out the State of Observability 2021 survey.

# Branching out with Spring Native

When we asked about areas where Spring could be improved, two rose to the top: *reduce startup time* and *optimize memory usage*. By compiling Spring apps into native executables, Spring Native addresses these challenges—and it's poised to take off.

## People know about Spring Native, but it's still early

Everyone knows about Spring Native (94%), and quite a few are evaluating it (32%), but almost no one (just 3%) is actively using it...yet. When asked what interests them about Spring Native, the top answers were *startup time* (70%), *works well with containers and Kubernetes* (50%), and *reduces costs of hosting* (45%).
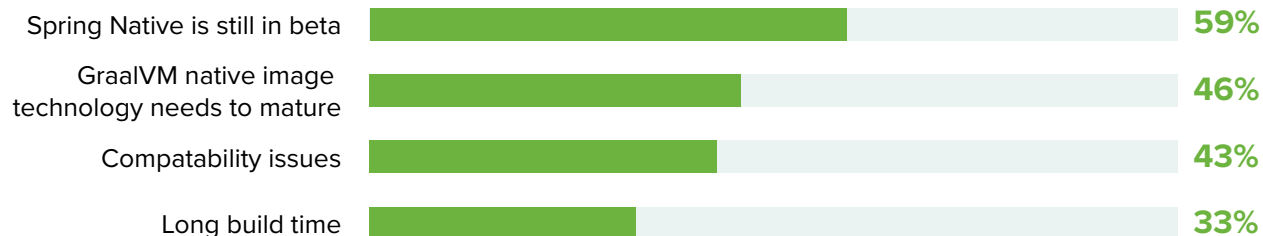
**94%**
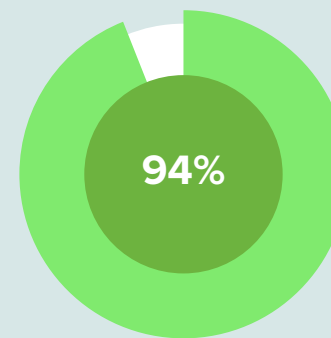
**Are aware of Spring Native**

**3%**
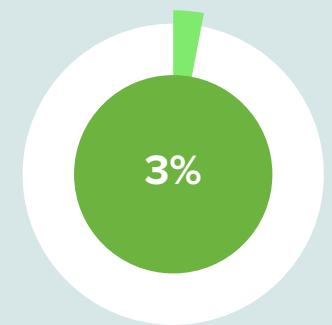
**Are actively using Spring Native**

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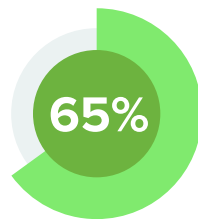spring®

## Why the hesitation?

The top barriers to Spring Native adoption are: *still in beta* (59%) and *GraalVM native image technology needs to mature* (46%). The fact that 92% of stakeholders view GraalVM positively suggests that the community is confident the technology will mature quickly.

**Top barriers to Native adoption**

| | |
|---|---|
| Spring Native is still in beta | **59%** |
| GraalVM native image technology needs to mature | **46%** |
| Compatability issues | **43%** |
| Long build time | **33%** |

## A future so bright...

Spring Native entered public beta in March 2021. Even though Spring Native is still in beta, 65% are already planning to deploy it: 29% in the next 12 months, another 29% in a 1-2 year timeframe, and a further 7% within 5 years.

**65%** of respondents say they plan to deploy **Spring Native**

# kubernetes

## Spring on Kubernetes is taking off

The number of organizations running containerized Spring apps on Kubernetes spiked up to 57% from 44% last year. This 13 point jump is in keeping with the rapid adoption of Kubernetes across the industry. Nine out ten respondents would like to see better support for Kubernetes, including *Kubernetes-native Service Discovery and config management* (67%), *streamlined Spring Boot app container image pipeline* (57%), and *application management of Spring applications* (52%).

For more on Kubernetes, see **State of Kubernetes 2021**

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# Summary and recommendations

Spring continues to thrive, with 61% of organizations surveyed saying it is their primary or only development platform, up from 52% . A staggering 95% agree that Spring Boot has a huge positive impact on productivity and 90% say Spring's impact is bigger than other Java platforms. Stack Overflow and Spring.io are once again the top sources of information for the Spring Community. We'll be working on Spring.io throughout the year to address the community's feedback on site usability and content discoverability.
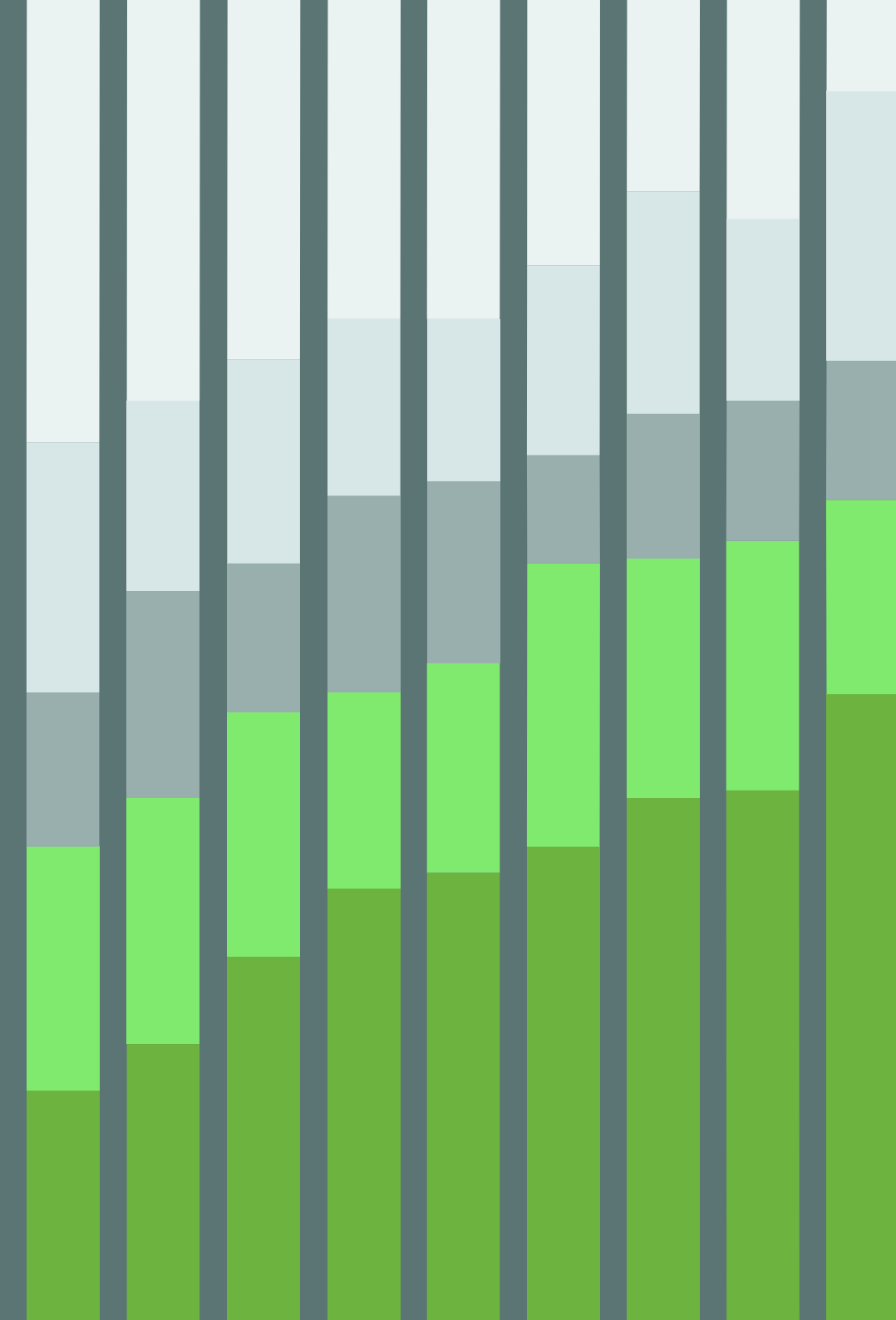
Key to the immense productivity that Spring unlocks are the many Spring Projects that help accelerate code delivery. For example, almost 80% of organizations use Spring Data—which integrates with leading data technologies including MongoDB, Redis and Elasticsearch. If you're looking for the right Spring Project to accelerate your development efforts, it may help to know that your peers base their decisions on project maturity and documentation quality.

Of the 86% of respondents using modern architectures, 94% are using microservices, while 35% are using Reactive, and 19% use Serverless.

The vast majority (97%) of survey respondents said that APIs are critical to their development efforts. While JSON over HTTP and OpenAPI predominate, a surprising 20% are already using APIs with GraphQL. If your organization is seeing rapid API proliferation, take a look at Spring Cloud Gateway and API Portal to help streamline API management.

Everyone in the Spring Community seems to know about Spring Native. Because it's still in beta, few are using it, but Spring Native is well positioned for rapid adoption in the near future.

With its large ecosystem and proven track record, Spring remains the platform of choice for enterprise Java, and there's much more to come. This annual survey is an invaluable resource as we work with the Spring Community to prioritize new areas for innovation and identify and resolve issues. Thanks for taking time to read this report. If you also participated in the survey, thank you for your feedback!

Visit **Spring.io** for all the resources, training, documentation, and much more as you continue your journey into the world of Spring.